



Mr. Jim Colmer, P.E., BB&E

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GREEN AND SUSTAINABLE REMEDIATION: APPLICATION WITHIN THE AIR NATIONAL GUARD

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Overview

- Air National Guard's (ANG) Green and Sustainable Remediation (GSR) Approach
- ANG's application of GSR
 - Tucson, AZ
 - Burlington, VT
 - Cheyenne, WY



ANG's RPO and GSR



- RPO is a tool by which the Air Force evaluates the status of remediation processes at sites
- RPO Primary Goals:
 1. Ensure protection of human health and environment
 2. Control Risk
 3. Improve cleanup efficiency (cost and time)
- GSR Primary Goal
 - Improve GSR parameters of existing remedies without compromising #1

GSR Evaluation



- Determine Scope
- Identifies opportunities to improve GSR parameters of existing remedies
 - Energy efficiency
 - Decrease air emissions (including CO₂)
 - Minimize material use and wastes generated
 - Minimize water use and maximize water reuse
 - Minimize soil and habitat disturbance
 - Improve long-term stewardship
- Ensure protection of human health and the environment

Case Study

Tucson, ANGB

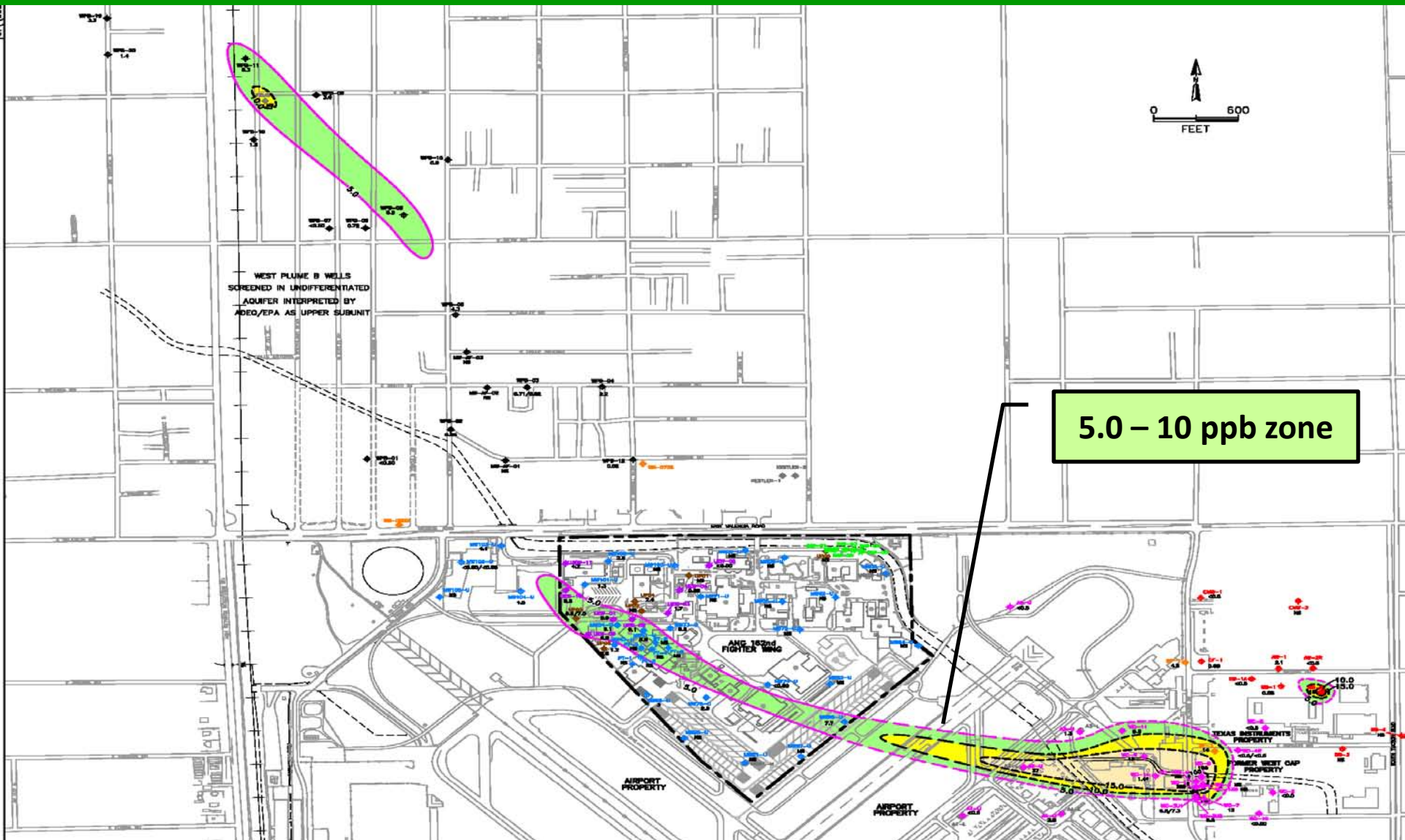
- Arizona Air National Guard, 162nd Fighter Wing, Tucson, Arizona
 - Portion of the Tucson International Airport Area Superfund Site
 - Primary chemical of concern – Trichloroethene (TCE)
 - Record of Decision (ROD)
 - Remedy Groundwater Extraction, Treatment, and Recharge System (GWETRS)
 - Groundwater capture and control
- Community Setting
 - Engaged Community
 - Downgradient water treatment infrastructure



This aerial map of Tucson, Arizona, highlights the Tucson Airport Remediation Project (TARP) area in pink. The map shows the project's extent from the airport towards the city center. Key locations and roads labeled include:

- Roads:** Tucson Rd, Valencia Rd, Los Reales Rd, Nogales Hwy, Hughes Access Rd, Tucson Rd, Tucson Rd, Tucson Rd.
- Water Bodies:** San Pedro River, San Pedro River.
- Locations:** Tucson Airport Remediation Project (TARP), West Plume B, Arizona Air National Guard, Texas Instruments, West Cap, Airport Property-Zone E, Air Force Plant 44 (Raytheon).

Plume B Area



- **15 Groundwater extraction pumps**
- **Pretreatment with sequestering agent**
- **Two air strippers**
- **Vapor-phase Granular Activated Carbon (GAC) treatment**
- **Reinjection of treated groundwater through 5 injection wells**



Tucson - System Metrics



- 1997 – March 2010
 - Captured 708M gallons and removed ~ 37 lbs TCE (just over 3 gallons)
- April 2009 - March 2010
 - Influent ranges between 4.3 – 5.5 $\mu\text{g/L}$
- Averages based on 2008 GSR Evaluation
 - Average monthly energy consumption 22K (kilowatt-hours) kWh or 265K kWh per year (2.34% base annual consumption)
 - 249 metric tons CO_2 equivalents (e) emitted based on energy use
 - 14 metric tons (MT) CO_2 based on transportation
 - About 9 miles of polyethylene tubing (PET) used annually

Tucson Substantive Recommendations



- Based on continuation of GWETRS operations
 - Energy (reductions of over 50%)
 - Discontinue /reconfigure select equipment (e.g., cascade aeration)
 - Replace air strippers with liquid-phase granular activated carbon (GAC)
 - Remove vapor-phase treatment due to low concentrations
 - Material use & waste minimization
 - Initiate passive sampling validation study

GSR Actions



- Passive cooling
 - GSR Evaluation completed April 2009
 - Findings presented to USEPA Region 9, August 2009
-
- In-situ Chemical Oxidation (ISCO) Pilot Test conducted in 2009
 - USEPA Region 9 and ANG working toward the goal of shutting the GWETRS down in favor of a more sustainable approach

Case Study

Burlington, ANGB

- Vermont Air National Guard, 158th Fighter Wing, Burlington, Vermont
 - Five active sites with cleanup underway
 - Primary chemicals of concern
 - Chlorinated solvents
 - Petroleum constituents
 - Free product (JP-4, JP-8)
 - GSR Evaluation completed September 2009



Burlington System Details

- Two operating Multi-Phase Extraction (MPE) Systems with product recovery and catalytic oxidation (CATOX) vapor treatment
- Bioventing System
- Pump and Treat (discharge to the City of Burlington Treatment Works)
- Soil Vapor Extraction (SVE)



Burlington System Metrics

- Contaminants removed
 - Pounds of CO₂ equivalents emitted per pound of contaminant removed (energy use only)
 - Site 1 Pump & Treat ~ 4,400
 - Site 2 SVE ~ 276
 - Site 3 MPE ~ 256
 - Site 4 Bioventing ~ 63
 - Site 5B MPE ~ 400
 - Electricity consumption
 - 946 mega-watt hours annually (20% of entire installation energy usage)
 - Free product removal
 - 38,200 pounds over system lifetimes
 - Tailpipe emissions
 - Approximately 40 metric tons per year (all sites)

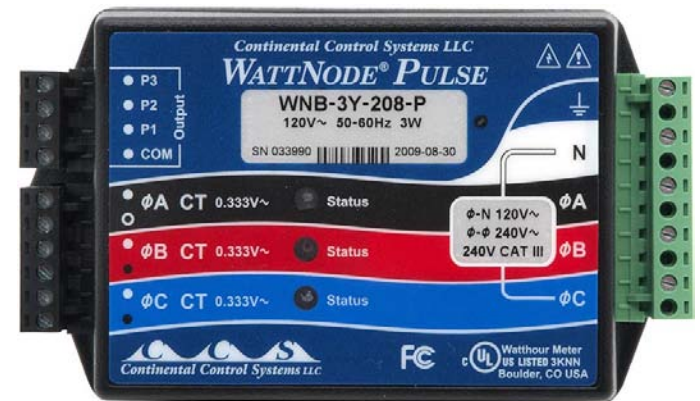


Burlington Substantive Recommendations



- Replace CATOX units (70 kW demand each) with vapor-phase GAC
 - Significant energy reduction

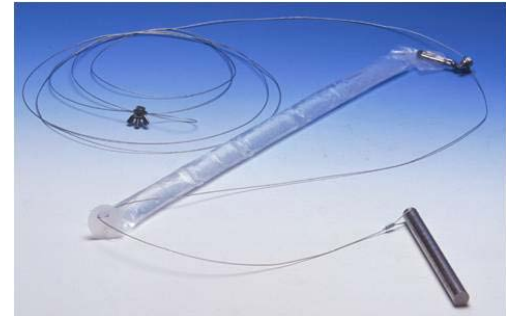
- Installation of energy management devices
 - Improve energy tracking and isolation of energy draw



Burlington Substantive Recommendations

- Use passive samplers for groundwater monitoring

- Reduction in material usage



- Use of local/regional vendors and suppliers
 - To the extent practicable to reduce tailpipe emissions



GSR Actions

- Base Wind Power Study completed 2009
 - Poor wind resources at the Base
- Solar powered AS/SVE analysis completed December 15, 2010
 - Over 20 yrs solar cost approximately \$245,000 more than traditional power
- Effectiveness comparison for replacing CATOX vapor treatment with vapor-phase GAC completed December 15, 2010
 - GAC costs approximately \$600K less over 10 years
 - Single CATOX use responsible for > 20 MT CO₂e/yr
 - Vermont Hazardous Ambient Air Standards initially not met with GAC for methylene chloride



Case Study

Cheyenne, ANGB

- Wyoming Air National Guard, 153rd Airlift Wing, Cheyenne, Wyoming
 - Contamination migrates off-base
 - Primary chemicals of concern
 - TCE
 - Carbon Tetrachloride
 - Groundwater capture system (building, well vaults, and discharge) located in a community park.
- GSR Evaluation completed October 2010





Cheyenne, WY ANGB Site 4

Community Involvement

- Legacy
 - Founder's Day Air Show
 - Earth Day: Environmental booth where Site 4 clean-up information is provided
 - Wing Commander regularly briefed on community involvement
- Site 4 Specifics
 - Door-to-door communication to residents about Site 4 plume accompanied by WDEQ
 - Private well water sampling and installation of individual water treatment systems as needed until conversion to municipal water
 - Residential vapor intrusion studies
 - Park treatment system installed during off-peak hours
 - Quiet equipment
 - Provided additional paved parking in the Park



Mylar Park

Bicycle Path, Fishing,
Pond, Picnic Facilities,
Play Area, Rental
Shelter, Restroom,
Horseshoes,
Volleyball and Grills



Cheyenne System Metrics



- Low influent concentrations
 - Approximately (20 $\mu\text{g/l}$) total volatile organic compounds
- Based on a mass removal rate of nearly 1.2 lbs/year:
 - 830 lbs of GAC used/lb contaminant removed
 - 29 MT of CO_2e emitted/lb contaminant removed
 - 5.4M gallons of water processed/lb contaminant removed
- Over 3 miles of PET used annually
- Electricity consumption
 - 52.4 mega-watt hours annually (just over 1% of entire installation energy usage)
- Tailpipe emissions
 - Approximately 12.6 MT per year CO_2

Cheyenne Substantive Recommendations

- Optimize system with energy efficient equipment
- Wind is an abundant renewable resource in Wyoming
 - Evaluate opportunities to power the groundwater capture system with wind
- Eliminate NPDES discharge exceedences by enhancing breakthrough protection/minimizing fouling
- Move toward a more passive remedial option



Cheyenne Substantive Recommendations

- Material use & waste minimization
 - Initiate passive sampler validation study
- Community Education
 - Create a walking tour of the park treatment system through interpretive panels



Questions & Contact Information



Mr. Jim Colmer, P.E.; (248) 489-9636, x309
jcolmer@bbande.com